

# Outcomes by Gender and Ethnicity After Percutaneous Coronary Intervention



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**Limited data on gender differences by ethnicity after percutaneous coronary intervention (PCI) exist. In this prospective cohort study, we examined gender differences in 1-year outcomes among patients from 4 ethnic groups who underwent PCI from 2010 to 2016 at a tertiary center. The primary outcome was 1-year major adverse cardiovascular events (MACE) defined as composite of all-cause death, nonfatal myocardial infarction (MI), or target lesion revascularization. Secondary outcomes included composite of death or MI and individual components of MACE. Baseline characteristics and outcomes were compared between gender in each ethnic group. The study included 16,361 patients: 7,881 whites (26.1% women), 1,943 blacks (47.3% women), 2,621 Asians (22.6% women), and 3,916 Hispanics (39.3% women). Women were older with more co-morbidities than men. Unadjusted, women had higher incidence of 1-year MACE than men among whites and Asians but not blacks or Hispanics, which was driven by a greater incidence of death in white women and greater incidence of MI in Asian women compared with male counterparts. After adjustment, findings showed similar risk of 1-year MACE in women versus men in whites, Asians, and Hispanics (Whites: hazard ratio [HR] 0.95, 95% confidence interval [CI] 0.78 to 1.16; Asians: HR 1.14, 95% CI 0.77 to 1.67; Hispanics: HR 0.97, 95% CI 0.74 to 1.27). Black women had lower risk of 1-year MACE compared with black men (HR 0.67, 95% CI 0.46 to 0.97), driven by lower risk of death or MI. In conclusion, this study suggests that risk factors account for adverse events in women after PCI. © 2019 Elsevier Inc. All rights reserved. (Am J Cardiol 2019;123:1941–1948)**

Historically, women have worse outcomes after percutaneous coronary intervention (PCI) compared with men.<sup>1–7</sup> This may be explained by older age at presentation and greater number of co-morbidities.<sup>1,4–8</sup> Furthermore, women more often have smaller and more tortuous coronary arteries than men and are prone to greater procedural complications.<sup>3,5,9–11</sup> Consequently, women are less likely to be treated with invasive treatments and evidence-based medications.<sup>12–14</sup> The higher rate of adverse outcomes in women has been noted even within specific ethnic populations, such as whites, blacks, and Asians, compared with their male counterparts.<sup>5,13,15,16</sup> However, these data are limited and not all consistent. Higher rates have been shown in some but not all studies. Moreover, ethnic minorities and women typically tend to be under-represented in PCI studies.<sup>5,6,13</sup> The purpose of this study was to compare 1-year clinical outcomes after PCI by gender among different ethnic groups, with heterogeneity testing for the effect of gender and ethnicity, from a large, single tertiary center PCI

registry catering to a diverse ethnic and socioeconomic patient population.

## Methods

The study population included all consecutive patients with data on ethnicity who underwent PCI at a single tertiary center from January 1, 2010 to May 31, 2016 (n = 16,361). Prospectively collected data were retrospectively examined. The patients were stratified into 4 ethnic groups, which included whites (n = 7,881), blacks (n = 1,943), Asians (n = 2,621), and Hispanics (n = 3,916). Baseline and procedural characteristics as well as in-hospital and 1-year clinical outcomes were compared by gender in each ethnic group. The primary end point was 1-year major adverse cardiovascular events (MACE), which was defined as composite of all-cause death, nonfatal myocardial infarction (MI), or target lesion revascularization (TLR). Secondary end points included composite of death or MI as well as individual components of MACE. Categorical variables were presented as numbers and percentages, and compared using the chi-square test. Continuous variables with normal distribution were presented as means with standard deviations and compared using the Student's *t* test. The cumulative incidence of adverse events was calculated as a Kaplan-Meier estimate of time to first event and comparisons between genders within each ethnic group were

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analyzed using the log-rank test. Cox proportional hazards regression model was used to calculate adjusted hazard ratios with 95% confidence intervals on outcomes in women compared with men in each ethnic group. The following variables were included in the models: age, body mass index, diabetes mellitus, chronic kidney disease, hypertension, hyperlipidemia, smoking, hemoglobin level, acute coronary syndrome, stent type, stent length and diameter, and multivessel disease (defined as >1 major epicardial coronary vessel with  $\geq 50\%$  diameter stenosis). Statistical analyses were performed using SAS version 9.3 (Cary, North Carolina) and Stata version 12.1 (College Station, Texas). A p value of  $<0.05$  was considered statistically significant for all tests.

## Results

A total of 16,361 patients were included in the study, composed of 7,881 whites (26.1% women), 1,943 blacks (47.3% women), 2,621 Asians (22.6% women), and 3,916 Hispanics (39.3% women). Baseline characteristics in women and men in each ethnic group are shown in [Table 1](#). At the time of PCI, white women and men represented the oldest group, whereas Asian women and men were the youngest. Within each ethnic group, women were older than men. Black and Asian women had greater body mass index compared with male counterparts.

There was a greater prevalence of hypertension, diabetes mellitus, and chronic kidney disease in women than men in each ethnic group, with diabetes being particularly more common in Asian women compared with Asian men. Cerebrovascular disease was also more common in women than men in all groups except Hispanics. Hyperlipidemia was significantly higher in black women only compared with black men. Fewer women had a history of previous MI or coronary artery bypass grafting than men in all ethnic groups except blacks, in whom previous revascularization rates were similar to men.

In all groups, women had lower hemoglobin levels and higher total cholesterol compared with men, the latter being mainly driven by increased high density lipoprotein levels. Women more commonly presented with unstable angina in all groups except Asians. White women also presented more frequently with non-ST-segment-elevation MI than white men. There was no significant difference in type of presentation between Asian women and men.

Angiographic findings and procedural complications are shown in [Table 2](#). Women had higher left ventricular ejection fractions and shorter coronary lesions compared with men in all ethnic groups. White and Hispanic women had fewer American College of Cardiology/American Heart Association B2 or C type lesions but more calcified lesions compared with men. Women also had significantly less chronic total occlusions and multivessel disease compared with men except among blacks.

No difference was noted in PCI therapy between genders. Overall, second generation everolimus-eluting stents were used most commonly in all patients. First generation paclitaxel-eluting stents were used more frequently in women than men among whites, blacks, and Hispanics. Stent length and diameter both were smaller in women

compared with men. White women had more complications than white men including postprocedural MI, cerebrovascular accident, and bleeding. Complication rates were similar between genders in the other ethnic groups.

Medical therapies given to each group are shown in [Table 3](#). On discharge, aspirin and dual antiplatelet therapy were prescribed similarly across all groups. Statin use remained higher in black women compared with men and was equivalent between genders in Asians and Hispanics. However, fewer white women received statins on discharge compared with white men. Among the prescribed P2Y12 inhibitors, women received more clopidogrel and less prasugrel compared with male counterparts among whites, Asians, and Hispanics. White women also received less ticagrelor.

[Figure 1](#) displays the Kaplan Meier plots of the cumulative incidence of 1-year MACE by gender in each ethnic group and [Figure 2](#) shows forest plots of both unadjusted and adjusted hazard ratios for 1-year outcomes. Women had a higher incidence of 1-year MACE than men among whites and Asians, but similar incidence compared with men among blacks and Hispanics. This finding was driven by a greater risk of death in white women and a greater risk of MI in Asian women compared with male counterparts. However, white women had lower rates of TLR compared with men, whereas Asian women had similar risk of TLR compared with Asian men.

After adjustment, the gender differences were attenuated, showing similar risk of 1-year MACE in women compared with men in whites, Asians, and Hispanics. Black women had a slightly lower risk of 1-year MACE compared with black men, driven by lower risk of death or MI. White women still had a lower incidence of TLR compared with white men. Asian women were noted to have a higher MI incidence compared with Asian men, although this did not meet statistical significance.

## Discussion

This present study presents gender differences in 1-year PCI outcomes among 4 ethnic populations from a large volume tertiary center with a socioeconomically diverse patient population. Women were older than men, had more co-morbidities, and were less likely discharged on optimal medical therapy. Women had a higher incidence of 1-year MACE compared with men among whites and Asians only. After adjustment, MACE rates were similar between genders in whites and Asians, suggesting that baseline co-morbidities rather than female gender alone contributed to the higher observed event rates. Interestingly black women had a significantly lower adjusted risk of 1-year MACE compared with black men.

Previous studies comparing gender differences in outcomes after PCI have identified women to be at higher risk of adverse events compared with men, but research on outcomes by gender and ethnicity is limited.<sup>1-7</sup> Women tend to be older with more co-morbidities at the time of presentation and can have more complex vascular anatomy, increasing their risk of procedural complications.<sup>1,4-10</sup> Among PCI cohorts, more women than men are black and Hispanic, and these ethnic groups tend to be at risk for

Table 1  
Baseline characteristics and presentation

	Whites n = 7881			Blacks n = 1943			Asians n = 2621			Hispanics n = 3916		
	Female n = 2054	Male n = 5827	p value	Female n = 920	Male n = 1023	p value	Female n = 593	Male n = 2028	p value	Female n = 1539	Male n = 2377	p value
<i>Baseline characteristics</i>												
Age (years)	72.0 ± 10.8	67.0 ± 11.6	<0.0001	65.2 ± 11.8	61.7 ± 11.4	<0.0001	64.6 ± 10.1	60.8 ± 10.4	<0.0001	68.4 ± 10.7	65.1 ± 11.1	<0.0001
BMI (kg/m <sup>2</sup> )	29.2 ± 6.6	29.3 ± 5.5	0.396	31.2 ± 6.9	29.1 ± 5.7	<0.0001	27.4 ± 5.2	26.7 ± 4.2	0.0005	29.4 ± 6.0	29.1 ± 5.3	0.108
Hypertension	1912 (93.2%)	5288 (90.8%)	0.0009	890 (96.8%)	968 (94.6%)	0.016	576 (97.1%)	1900 (93.7%)	0.001	1483 (96.4%)	2254 (94.9%)	0.028
Hyperlipidemia	1942 (94.6%)	5492 (94.3%)	0.547	875 (95.2%)	929 (90.8%)	0.0002	562 (94.8%)	1945 (95.9%)	0.233	1483 (96.4%)	2262 (95.2%)	0.082
Diabetes mellitus	794 (38.7%)	2044 (35.1%)	0.004	542 (59.0%)	493 (48.2%)	<0.0001	418 (70.5%)	1144 (56.4%)	<0.0001	944 (61.3%)	1277 (53.7%)	<0.0001
CKD*	773 (37.6%)	1540 (26.4%)	<0.0001	329 (35.8%)	293 (28.6%)	0.0008	174 (29.3%)	396 (19.5%)	<0.0001	544 (35.3%)	618 (26.0%)	<0.0001
Anemia	805 (40.1%)	1930 (33.8%)	<0.0001	490 (54.7%)	514 (51.5%)	0.158	327 (55.9%)	789 (39.6%)	<0.0001	653 (42.9%)	962 (41.1%)	0.263
Current smoker	262 (12.8%)	829 (14.2%)	0.099	158 (17.2%)	240 (23.5%)	0.0006	13 (2.2%)	308 (15.2%)	<0.0001	164 (10.7%)	337 (14.2%)	0.001
Lung disease <sup>†</sup>	276 (13.5%)	484 (8.3%)	<0.0001	112 (12.2%)	77 (7.5%)	0.0005	14 (2.4%)	77 (3.8%)	0.093	162 (10.5%)	155 (6.5%)	<0.0001
Previous MI	475 (23.1%)	1564 (26.8%)	0.001	206 (22.4%)	229 (22.4%)	0.987	98 (16.5%)	459 (22.6%)	0.001	325 (21.1%)	637 (26.8%)	<0.0001
Previous CABG	279 (13.6%)	1190 (20.4%)	<0.0001	95 (10.3%)	108 (10.6%)	0.874	82 (13.8%)	373 (18.4%)	0.010	200 (13.0%)	382 (16.1%)	0.008
Cerebrovascular disease	239 (11.6%)	505 (8.7%)	<0.0001	156 (17.0%)	110 (10.8%)	<0.0001	59 (9.9%)	137 (6.8%)	0.009	189 (12.3%)	267 (11.2%)	0.318
Family history of CAD	644 (31.4%)	1828 (31.4%)	0.999	226 (24.6%)	238 (23.3%)	0.494	129 (21.8%)	454 (22.4%)	0.745	485 (31.5%)	657 (27.7%)	0.009
<i>Insurance</i>			<0.0001			0.339			0.059			0.002
Medicare/Medicaid	626 (30.5%)	1483 (25.5%)		175 (19.0%)	200 (19.6%)		108 (18.2%)	308 (15.2%)		313 (20.3%)	420 (17.7%)	
Private	447 (21.8%)	1790 (30.7%)		327 (35.5%)	403 (39.4%)		322 (54.3%)	1191 (58.7%)		533 (34.6%)	985 (41.4%)	
None	81 (3.9%)	228 (3.9%)		23 (2.5%)	18 (1.8%)		26 (4.4%)	119 (5.9%)		60 (3.9%)	111 (4.7%)	
Missing	900 (43.8%)	2326 (39.9%)		395 (42.9%)	402 (39.3%)		137 (23.1%)	410 (20.2%)		633 (41.1%)	861 (36.2%)	
<i>Presentation</i>												
Asymptomatic	56 (2.7%)	275 (4.7%)	0.0001	33 (3.6%)	46 (4.5%)	0.311	7 (1.2%)	67 (3.3%)	0.006	27 (1.8%)	81 (3.4%)	0.002
Stable angina	924 (45.0%)	2929 (50.3%)	<0.0001	382 (41.5%)	472 (46.1%)	0.041	360 (60.7%)	1211 (59.7%)	0.664	807 (52.4%)	1297 (54.6%)	0.192
UA	758 (36.9%)	1891 (32.5%)	0.0002	332 (36.1%)	325 (31.8%)	0.045	176 (29.7%)	578 (28.5%)	0.577	504 (32.7%)	690 (29.0%)	0.014
NSTEMI	261 (12.7%)	600 (10.3%)	0.003	144 (15.7%)	132 (12.9%)	0.083	41 (6.9%)	137 (6.8%)	0.893	154 (10.0%)	233 (9.8%)	0.834
STEMI	51 (2.5%)	124 (2.1%)	0.348	26 (2.8%)	47 (4.6%)	0.041	8 (1.3%)	33 (1.6%)	0.631	40 (2.6%)	72 (3.0%)	0.431
<i>Lab values</i>												
Hemoglobin (g/dl)	12.24 ± 1.54	13.44 ± 1.71	<0.0001	11.70 ± 1.50	12.77 ± 1.76	<0.0001	11.77 ± 1.33	13.25 ± 1.57	<0.0001	12.13 ± 1.46	13.18 ± 1.71	<0.0001
Creatinine (mg/dl)	1.03 ± 0.75	1.21 ± 0.90	<0.0001	1.55 ± 1.81	2.04 ± 2.61	<0.0001	1.12 ± 1.20	1.21 ± 1.05	0.079	1.06 ± 0.85	1.39 ± 1.44	<0.0001
Total cholesterol (mg/dl)	154.53 ± 44.43	139.28 ± 45.40	<0.0001	159.28 ± 51.14	148.53 ± 43.42	<0.0001	146.92 ± 50.85	136.21 ± 49.87	<0.0001	157.91 ± 53.64	139.59 ± 39.08	<0.0001
LDL (mg/dl)	89.15 ± 75.98	84.02 ± 87.70	0.020	97.78 ± 93.91	93.30 ± 84.66	0.275	87.56 ± 98.20	86.37 ± 107.52	0.811	93.43 ± 79.77	86.54 ± 92.76	0.018
HDL (mg/dl)	48.90 ± 14.69	40.51 ± 11.79	<0.0001	50.33 ± 15.38	43.11 ± 13.06	<0.0001	43.33 ± 11.74	37.23 ± 9.68	<0.0001	45.83 ± 12.68	38.50 ± 10.51	<0.0001

BMI = body mass index; CABG = coronary artery bypass grafting; CAD = coronary artery disease; CKD = chronic kidney disease; HDL = high density lipoprotein; LDL = low density lipoprotein; MI = myocardial infarction; NSTEMI = non-ST-segment-elevation myocardial infarction; STEMI = ST-segment-elevation myocardial infarction; UA = unstable angina.

\* CKD = estimated glomerular filtration rate <60 ml/min or on dialysis.

<sup>†</sup> Lung disease = chronic obstructive pulmonary disease, asthma, pulmonary hypertension, interstitial lung disease or fibrosis.

Table 2  
Angiographic findings and procedural complications

	Whites n = 7881			Blacks n = 1943			Asians n = 2621			Hispanics n = 3916		
	Female n = 2054	Male n = 5827	p value	Female n = 920	Male n = 1023	p value	Female n = 593	Male n = 2028	p value	Female n = 1539	Male n = 2377	p value
LVEF (%)	55.18 ± 10.02	53.28 ± 10.81	<0.0001	55.13 ± 10.41	51.57 ± 12.17	<0.0001	57.24 ± 8.84	54.73 ± 10.17	<0.0001	55.53 ± 10.18	52.55 ± 11.45	<0.0001
Lesion length	27.70 ± 21.15	30.57 ± 21.91	<0.0001	24.52 ± 17.60	26.42 ± 18.55	0.021	26.34 ± 18.21	29.45 ± 21.51	0.001	23.51 ± 16.90	26.36 ± 19.09	<0.0001
ISR	262 (12.8%)	895 (15.4%)	0.004	128 (13.9%)	159 (15.5%)	0.312	77 (13.0%)	320 (15.8%)	0.095	204 (13.3%)	361 (15.2%)	0.093
CTO	132 (6.4%)	540 (9.3%)	<0.0001	56 (6.1%)	83 (8.1%)	0.084	39 (6.6%)	194 (9.6%)	0.025	81 (5.3%)	177 (7.4%)	0.007
Bifurcation	378 (18.4%)	980 (16.8%)	0.102	108 (11.7%)	137 (13.4%)	0.273	91 (15.3%)	330 (16.3%)	0.589	222 (14.4%)	338 (14.2%)	0.858
B2 or C	1544 (75.2%)	4648 (79.8%)	<0.0001	666 (72.4%)	747 (73.0%)	0.756	404 (68.1%)	1465 (72.2%)	0.052	1057 (68.7%)	1718 (72.3%)	0.016
Thrombotic	143 (7.0%)	453 (7.8%)	0.231	57 (6.2%)	79 (7.7%)	0.188	19 (3.2%)	104 (5.1%)	0.051	82 (5.3%)	177 (7.4%)	0.009
Calcification			0.022			0.791			0.317			<0.0001
None/mild	1446 (70.4%)	4259 (73.1%)		756 (82.2%)	836 (81.7%)		483 (81.5%)	1672 (82.4%)		1233 (80.1%)	1994 (83.9%)	
Moderate	246 (12.0%)	583 (10.0%)		70 (7.6%)	79 (7.7%)		43 (7.3%)	169 (8.3%)		161 (10.5%)	148 (6.2%)	
Severe	296 (14.4%)	800 (13.7%)		49 (5.3%)	62 (6.1%)		50 (8.4%)	139 (6.9%)		76 (4.9%)	140 (5.9%)	
Vessel												
LM	119 (5.8%)	293 (5.0%)	0.180	32 (3.5%)	31 (3.0%)	0.578	19 (3.2%)	62 (3.1%)	0.856	42 (2.7%)	66 (2.8%)	0.929
LAD	1052 (51.2%)	2707 (46.5%)	0.0002	385 (41.8%)	424 (41.4%)	0.858	316 (53.3%)	943 (46.5%)	0.004	734 (47.7%)	1051 (44.2%)	0.033
LCx	555 (27.0%)	1898 (32.6%)	<0.0001	265 (28.8%)	341 (33.3%)	0.031	158 (26.6%)	672 (33.1%)	0.003	405 (26.3%)	712 (30.0%)	0.014
RCA	559 (27.2%)	1605 (27.5%)	0.774	298 (32.4%)	287 (28.1%)	0.038	147 (24.8%)	545 (26.9%)	0.311	412 (26.8%)	641 (27.0%)	0.893
Multivessel*	1192 (58.0%)	4041 (69.3%)	<0.0001	550 (59.8%)	654 (63.9%)	0.060	351 (59.2%)	1408 (69.4%)	<0.0001	888 (57.7%)	1576 (66.3%)	<0.0001
PCI stent	1923 (93.6%)	5442 (93.4%)	0.718	849 (92.3%)	920 (89.9%)	0.070	551 (92.9%)	1870 (92.2%)	0.568	1410 (91.6%)	2207 (92.8%)	0.157
Paclitaxel-eluting	79 (3.8%)	160 (2.7%)	0.012	47 (5.1%)	31 (3.0%)	0.020	8 (1.3%)	25 (1.2%)	0.823	63 (4.1%)	66 (2.8%)	0.024
Everolimus-eluting – CoCr	1243 (60.5%)	3545 (60.8%)	0.798	495 (53.8%)	532 (52.0%)	0.427	322 (54.3%)	1178 (58.1%)	0.101	922 (59.9%)	1370 (57.6%)	0.158
Everolimus-eluting – PtCr	388 (18.9%)	1200 (20.6%)	0.098	153 (16.6%)	192 (18.8%)	0.218	100 (16.9%)	406 (20.0%)	0.087	245 (15.9%)	483 (20.3%)	0.0005
Stent length	30.97 ± 19.7	33.49 ± 20.37	<0.0001	28.74 ± 18.78	30.26 ± 17.98	0.083	29.71 ± 17.6	32.97 ± 20.77	0.0008	27.38 ± 16.33	30.27 ± 19.3	<0.0001
Stent diameter	3.12 ± 0.46	3.19 ± 0.49	<0.0001	3.09 ± 0.47	3.14 ± 0.50	0.023	2.97 ± 0.39	3.03 ± 0.47	0.0025	3.02 ± 0.44	3.07 ± 0.47	0.0011
Procedural complications												
Any dissection	69 (3.4%)	117 (2.0%)	0.0005	21 (2.3%)	16 (1.6%)	0.247	13 (2.2%)	36 (1.8%)	0.510	25 (1.6%)	34 (1.4%)	0.626
Grade 3 dissection	17 (0.8%)	17 (0.3%)	0.001	4 (0.4%)	3 (0.3%)	0.603	4 (0.7%)	7 (0.3%)	0.275	6 (0.4%)	4 (0.2%)	0.180
Side branch closure	69 (3.4%)	143 (2.5%)	0.029	15 (1.6%)	22 (2.2%)	0.402	12 (2.0%)	42 (2.1%)	0.943	44 (2.9%)	52 (2.2%)	0.185
Perforation	16 (0.8%)	37 (0.6%)	0.492	5 (0.5%)	6 (0.6%)	0.900	1 (0.2%)	14 (0.7%)	0.139	6 (0.4%)	17 (0.7%)	0.193
Tamponade	2 (0.1%)	6 (0.1%)	0.945	0 (0.0%)	0 (0.0%)	0.442	0 (0.0%)	3 (0.1%)	0.349	0 (0.0%)	4 (0.2%)	0.107
Slow flow/no flow	37 (1.8%)	72 (1.2%)	0.059	9 (1.0%)	6 (0.6%)	0.325	2 (0.3%)	26 (1.3%)	0.049	12 (0.8%)	19 (0.8%)	0.946
Vessel closure	7 (0.3%)	10 (0.2%)	0.155	1 (0.1%)	0 (0.0%)	0.292	2 (0.3%)	3 (0.1%)	0.353	3 (0.2%)	3 (0.1%)	0.591
In-hospital events												
Death	13 (0.6%)	14 (0.2%)	0.009	3 (0.3%)	5 (0.5%)	0.576	0 (0.0%)	4 (0.2%)	0.279	9 (0.6%)	4 (0.2%)	0.027
MI	102 (5.0%)	184 (3.2%)	0.0002	18 (2.0%)	23 (2.2%)	0.655	18 (3.0%)	90 (4.4%)	0.131	44 (2.9%)	58 (2.4%)	0.421
CABG	3 (0.1%)	5 (0.1%)	0.461	1 (0.1%)	0 (0.0%)	0.292	1 (0.2%)	1 (0.0%)	0.355	1 (0.1%)	4 (0.2%)	0.377
CHF	14 (0.7%)	26 (0.4%)	0.197	4 (0.4%)	5 (0.5%)	0.861	3 (0.5%)	6 (0.3%)	0.442	8 (0.5%)	12 (0.5%)	0.949
CVA	10 (0.5%)	11 (0.2%)	0.024	0 (0.0%)	3 (0.3%)	0.100	0 (0.0%)	1 (0.0%)	0.589	1 (0.1%)	2 (0.1%)	0.832
Dialysis	2 (0.1%)	4 (0.1%)	0.685	4 (0.4%)	4 (0.4%)	0.880	1 (0.2%)	4 (0.2%)	0.888	4 (0.3%)	6 (0.3%)	0.964
Composite bleed <sup>†</sup>	88 (4.3%)	138 (2.4%)	<0.0001	33 (3.6%)	22 (2.2%)	0.057	15 (2.5%)	40 (2.0%)	0.405	45 (2.9%)	52 (2.2%)	0.148
Blood transfusion	61 (3.0%)	87 (1.5%)	<0.0001	27 (2.9%)	13 (1.3%)	0.010	11 (1.9%)	20 (1.0%)	0.085	23 (1.5%)	32 (1.3%)	0.700
30 day readmission	90 (4.4%)	228 (3.9%)	0.353	40 (4.3%)	45 (4.4%)	0.956	22 (3.7%)	62 (3.1%)	0.427	74 (4.8%)	84 (3.5%)	0.048

CABG = coronary artery bypass grafting; CHF = congestive heart failure; CoCr = cobalt chromium; CTO = chronic total occlusion; CVA = cerebrovascular accident; ISR = in-stent restenosis; LAD = left anterior descending coronary artery; LCx = left circumflex coronary artery; LM = left main coronary artery; PCI = percutaneous coronary intervention; PtCr = platinum chromium; LVEF = left ventricular ejection fraction; MI = myocardial infarction; RCA = right coronary artery.

\* Multivessel = >1 major epicardial coronary vessel with ≥50% diameter stenosis.

<sup>†</sup> Composite bleed = hemoglobin drop >3, postprocedural bleed, or transfusion.

Table 3  
Admission and discharge medications

	Whites n = 7881			Blacks n = 1943			Asians n = 2621			Hispanics n = 3916		
	Female n = 2054	Male n = 5827	p value	Female n = 920	Male n = 1023	p value	Female n = 593	Male n = 2028	p value	Female n = 1539	Male n = 2377	p value
<i>Admission medications</i>												
Aspirin	1646 (80.1%)	4922 (84.5%)	<0.0001	756 (82.2%)	836 (81.7%)	0.795	511 (86.2%)	1819 (89.7%)	0.016	1282 (83.3%)	2015 (84.8%)	0.218
Statin	1490 (72.5%)	4355 (74.7%)	0.051	679 (73.8%)	659 (64.4%)	<0.0001	433 (73.0%)	1589 (78.4%)	0.007	1158 (75.2%)	1771 (74.5%)	0.603
Clopidogrel	785 (38.2%)	2223 (38.1%)	0.956	377 (41.0%)	372 (36.4%)	0.037	241 (40.6%)	885 (43.6%)	0.195	586 (38.1%)	917 (38.6%)	0.753
Prasugrel	40 (1.9%)	162 (2.8%)	0.040	22 (2.4%)	30 (2.9%)	0.461	14 (2.4%)	86 (4.2%)	0.036	38 (2.5%)	80 (3.4%)	0.109
Ticagrelor	23 (1.1%)	102 (1.8%)	0.049	8 (0.9%)	7 (0.7%)	0.641	3 (0.5%)	43 (2.1%)	0.008	16 (1.0%)	35 (1.5%)	0.243
Beta blocker	1464 (71.3%)	4089 (70.2%)	0.346	652 (70.9%)	732 (71.6%)	0.739	463 (78.1%)	1562 (77.0%)	0.590	1135 (73.7%)	1789 (75.3%)	0.287
RAAS inhibitor	1092 (53.2%)	3122 (53.6%)	0.747	565 (61.4%)	601 (58.7%)	0.231	342 (57.7%)	1080 (53.3%)	0.058	1003 (65.2%)	1462 (61.5%)	0.020
Calcium channel blocker	660 (32.1%)	1651 (28.3%)	0.001	449 (48.8%)	447 (43.7%)	0.024	262 (44.2%)	678 (33.4%)	<0.0001	706 (45.9%)	960 (40.4%)	0.0007
Coumadin	116 (5.6%)	370 (6.3%)	0.255	36 (3.9%)	40 (3.9%)	0.997	16 (2.7%)	32 (1.6%)	0.074	45 (2.9%)	87 (3.7%)	0.213
<i>Discharge medications</i>												
Aspirin	1971 (96.0%)	5639 (96.8%)	0.082	893 (97.1%)	997 (97.5%)	0.595	583 (98.3%)	1994 (98.3%)	0.987	1490 (96.8%)	2323 (97.7%)	0.082
Statin	1846 (89.9%)	5344 (91.7%)	0.011	845 (91.8%)	903 (88.3%)	0.009	556 (93.8%)	1926 (95.0%)	0.248	1403 (91.2%)	2188 (92.0%)	0.327
Clopidogrel	1764 (85.9%)	4633 (79.5%)	<0.0001	752 (81.7%)	812 (79.4%)	0.189	486 (82.0%)	1512 (74.6%)	0.0002	1251 (81.3%)	1852 (77.9%)	0.011
Prasugrel	138 (6.7%)	676 (11.6%)	<0.0001	90 (9.8%)	112 (10.9%)	0.401	55 (9.3%)	293 (14.4%)	0.001	133 (8.6%)	262 (11.0%)	0.016
Ticagrelor	121 (5.9%)	449 (7.7%)	0.006	68 (7.4%)	75 (7.3%)	0.960	52 (8.8%)	213 (10.5%)	0.218	138 (9.0%)	236 (9.9%)	0.317
DAPT	1948 (94.8%)	5577 (95.7%)	0.103	886 (96.3%)	978 (95.6%)	0.433	581 (98.0%)	1980 (97.6%)	0.623	1477 (96.0%)	2296 (96.6%)	0.312
Beta blocker	1656 (80.6%)	4680 (80.3%)	0.763	731 (79.5%)	852 (83.3%)	0.030	498 (84.0%)	1726 (85.1%)	0.500	1276 (82.9%)	1984 (83.5%)	0.649
Coumadin	132 (6.5%)	375 (6.4%)	0.995	40 (4.4%)	49 (4.8%)	0.643	17 (2.9%)	37 (1.8%)	0.117	48 (3.1%)	96 (4.0%)	0.137
Rivaroxaban	25 (1.2%)	84 (1.4%)	0.459	7 (0.8%)	12 (1.2%)	0.357	2 (0.3%)	8 (0.4%)	0.841	15 (1.0%)	17 (0.7%)	0.377
Dabigatran	18 (0.9%)	50 (0.9%)	0.933	2 (0.2%)	3 (0.3%)	0.742	0 (0.0%)	6 (0.3%)	0.185	10 (0.7%)	10 (0.4%)	0.325
Apixaban	12 (0.6%)	32 (0.6%)	0.850	1 (0.1%)	4 (0.4%)	0.220	2 (0.3%)	2 (0.1%)	0.191	4 (0.3%)	6 (0.3%)	0.962

DAPT = dual antiplatelet therapy; RAAS = renin-angiotensin-aldosterone system.

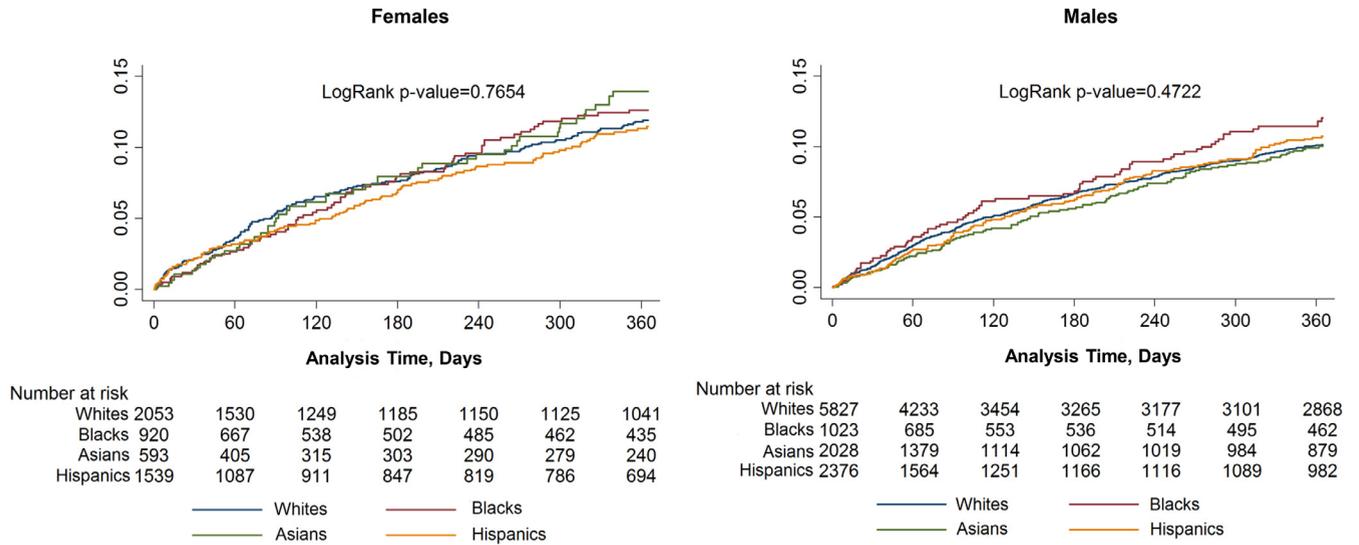


Figure 1. Cumulative MACE by ethnicity in females and males.

adverse outcomes with more co-morbidities.<sup>6,12,13,15,17-19</sup> However, to our knowledge, no single study has compared gender differences and long-term outcomes in 4 ethnic groups with a larger representation of black, Asian, and Hispanic women, as we have shown. Our findings were consistent with previous data noting women were older with more co-morbidities compared with men. Strikingly, Asians had the highest rates of diabetes mellitus rather than Hispanics, who reportedly tend to have more metabolic syndrome.<sup>20-22</sup>

Differences in angiographic findings and treatment strategies between men and women and in ethnic minorities have also been reported.<sup>4,6,9,12,14,19,23-25</sup> A higher prevalence of nonobstructive coronary artery disease (CAD) has been observed in women compared with men and in blacks compared with other ethnicities.<sup>13,26-28</sup> Women also tend

to have fewer chronic total occlusion lesions and shorter lesions compared with men.<sup>29-31</sup> We found similar results in our data. Interestingly, no difference was noted in PCI therapy between genders as had been previously described.<sup>13</sup> However, stent diameter was smaller in women, which could have been a function of smaller vessel size.<sup>6</sup> More postprocedural adverse events were noted in white women, which could have been from older age as well as more calcification noted on angiography. White women also received less potent P2Y12 inhibitors on discharge, likely due to increased risk of bleeding with age and postprocedural complications.<sup>5-7,10,15</sup>

Despite the higher incidence rates of adverse events in women, adjusting for baseline differences revealed similar MACE rates to men among whites, Asians, and Hispanics, with even lower rates in black women which reached

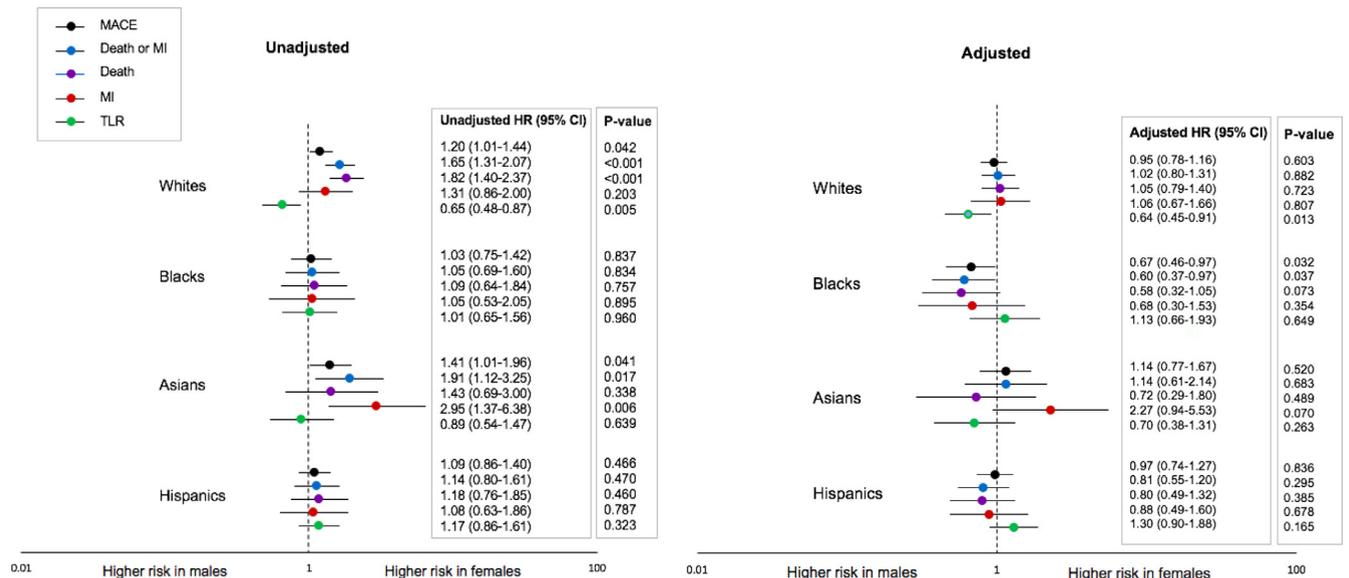


Figure 2. Unadjusted and adjusted hazard ratios for 1-year outcomes in females.

statistical significance. Some studies have reported higher risk of adverse events in women versus men in specific ethnic groups even after adjustment; however, they were limited by not having out-of-hospital outcomes or not comparing gender differences within ethnic groups.<sup>5,13</sup> One study comparing in-hospital outcomes by gender, ethnicity, and age found young Hispanic women to have significantly higher in-hospital mortality compared with young white men.<sup>22</sup> Recent data from the PLATINUM Diversity Study presented greater risk of 1-year death or MI among women and minorities (including blacks and Hispanics) compared with white men.<sup>32,33</sup> We did not replicate this finding.

Interestingly, we noted a trend of higher MI rates in Asian women compared with Asian men at 1 year after adjustment. Our population consisted of more South Asians, who are known to have a higher prevalence of CAD.<sup>34</sup> One recent study noted that South Asian women with acute coronary syndrome or stable angina and obstructive CAD have increased rates of all-cause death and hospital readmissions for MI, angina, heart failure, or cerebrovascular accident at 2 years compared with South Asian men.<sup>16</sup> This previous study did not compare rates of MI alone as we have presented.

Certainly, factors such as insurance status, compliance to medications, diet, exercise, and lifestyle modifications could also have influenced long-term outcomes between genders. The PLATINUM Diversity Study reported on baseline disparities in insurance and socioeconomic status among women and minorities, suggesting a possible role of these factors on adverse 1-year outcomes.<sup>32</sup> In our study, insurance status was similar between genders in minorities.

Our study has important limitations. This was a cohort study from a single tertiary center; however, all outcomes were prospectively collected by a dedicated research team. We only studied 1-year outcomes, and even longer term outcomes are of great interest. Although we used multiple Cox regression to adjust for differences in baseline characteristics, the possibility of residual confounding is still present. We did not have data on type of vascular access (femoral vs radial), length of medical therapy or adherence, and information on incomplete revascularization, which could have affected outcomes as well. Nonetheless, our observations serve as a reference for the planning of future studies in racial and ethnic minorities with long-term follow-up.

In conclusion, our study revealed that women who underwent PCI experienced a greater incidence of 1-year MACE compared with men in whites and Asians. Excess risk for cardiovascular events in women versus men was attenuated after controlling for baseline differences, with even lower risk of 1-year MACE in black women compared with black men. This finding suggests that risk factors rather than female gender alone had an adverse impact on outcomes. Asian women had a notable trend toward increased 1-year MI compared with men after PCI, perhaps due to disparities in treatment and unmeasured lifestyle factors.

## Disclosures

Roxana Mehran is a consultant for AstraZeneca, Bayer, CSL Behring, Janssen Pharmaceuticals, Merk & Co, The Medicines Co., and Watermark Consulting; serves on the

advisory board of Abbott Laboratories, AstraZeneca, Boston Scientific, Covidien, Janssen Pharmaceuticals, Merk & Co., The Medicines Co., and Sanofi-Aventis; gives industry-sponsored lectures for PlatformQ and Sanofi-Aventis; and has equity in Claret Medical and Elixir Medical Corp.

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